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Predicting and Preventing Visual Impairment and Blindness by Incorporating Individual Progression Velocity in Glaucoma Care

Taking into account age and life expectancy in glaucoma care seems mandatory, given the large proportion of glaucoma patients who will not suffer serious visual impairment at the time of death, reported by Saunders et al.[1] in the January 2014 issue. Only 5.2% of patients were predicted to progress to statuary blindness and another 10.4% to visual impairment.

It is not easy to incorporate the findings of Saunders et al. correctly in clinical decision making. Current prediction models do not allow for a reliable early identification of those patients who will become visually impaired or blind. This reassures the current need of initially treating most glaucoma patients, an approach that has been shown to be very cost-effective.[2,3] It also reassures that those who are at risk of visual impairment must be identified during follow-up to personalize the treatment intensity in a later stage. A tool to identify patients at risk of visual impairment is not available in current perimeter software and became available only recently for clinicians.[4] Saunders et al.[1] reported that those with a presenting mean deviation (MD) better than −6 dB (early glaucoma) are at a small risk. This rule, however, is only valid within the context of the authors' data collection, which was performed among patients treated in regular care in the United Kingdom. If clinicians take the message literally and delay or taper treatment in early glaucoma, visual impairment or blindness may no longer be rare in this group. In this letter we will address these issues from a clinician perspective.

In 2011, we published a tool[4] that can be used to estimate the probability of becoming visually impaired before dying, for newly diagnosed patients (that is, in a situation where the individual progression velocity is not yet known). Figures 1A (men) and 1B (women) show this tool again, now with the baseline data from the cohort of the Groningen Longitudinal Glaucoma Study (GLGS; described in detail previously[5,6]) plotted in the graphs. A random eye was chosen if both eyes were available. If the combination of age and MD is in the red area, the probability of becoming visually impaired before dying exceeds 2.5%, even if treated. In the green area, this probability is less than 2.5% even if left untreated. Visually impaired was defined as an MD of −20 dB or worse. It can be seen that at baseline most of the patients were in the red area. This indicates that it is not easy to identify patients at risk for blindness already at the time of diagnosis.

After at least five years of perimetric follow-up, individual progression velocities can be determined[7] and this allows for a refined estimate of the probability of becoming visually impaired before dying. We published another tool to help the clinician with this estimate as well.[4] We applied the latter tool to all patients from the GLGS with at least five years of perimetric follow-up (n = 160, mean follow-up 9.4 years).[8] Figure 2A presents these patients as either red or green dots, depending on their end-of life MD (red, end-of-life MD −20 dB or worse; green, better than −20 dB), calculated from individual progression velocities and the P95 of residual life expectancies (longevity). Figure 2B presents the corresponding results for median residual life expectancy. Clearly, there is a decrease in the percentage of patients at risk of reaching visual impairment compared to the situation in which the progression velocity is not yet known (Fig. 1). Furthermore, in Figure 2 there is a considerable overlap in age and MD for patients at risk and those not at risk of visual impairment, indicating that it is not possible to identify patients at risk merely by means of their age and MD. These findings illustrate the added value of the determination of individual progression velocities.

Saunders et al.[1] found that patients with early glaucoma at presentation were relatively spared from visual impairment. In agreement with them, there are no red dots in Figure 2B above −6 dB. However, as mentioned above, this is not a disease property, but a context-specific observation. Figure 3A presents the same calculations as Figure 2A, but now with the individual progression velocities tripled for all patients. In this situation, a presenting MD of −6 dB or better is no longer a guarantee for preserved sight. A tripled progression velocity is not unrealistic. In fact, it corresponds with a situation where the mean IOP during follow-up is only approximately 4 mm Hg higher. In the GLGS, the median (P90) progression velocity was −0.20 (−0.80) dB/y at a mean (SD) IOP during follow-up of 15 (3) mm Hg.[8,9] In a clinical cohort from Malmo, these values were −0.62 (−2.0) dB/y at an IOP of 19 (5) mm Hg.[10] Findings in agreement with the GLGS also were reported from a large clinical cohort in Canada and the Canadian Glaucoma Study (Chauhan B, et al. *IOVS* 2013;54:ARVO E-Abstract 2635). The influence of a tripled progression velocity remains clearly visible if we repeat the analysis with median residual life expectancy rather than the 95th percentile (Figs. 2B, 3B) and this is in line with the finding that the lifetime risk of open-angle glaucoma blindness increases with IOP.[11]

In conclusion, from a health-economical point of view, we want to know the percentage of glaucoma patients that will become visually impaired or blind, as was calculated by Saunders et al.[1] For a newly-diagnosed individual patient, and his/her physician, this information provides a global prognosis, but it will not have direct therapeutic consequences, since it is virtually impossible to say if this specific patient in the consulting room will become visually impaired or not. Most glaucoma patients deserve initially a tight IOP control, and this is a highly cost-effective approach even if only a small percentage eventually will become blind.[2,3] Taking into account life expectancy in glaucoma care is possible as soon as the individual progression velocity is known. In our hospital, the estimated end-of-life MD (Fig. 4) is available in our computer patient record, both for longevity (95th percentile of residual life expectancy, Fig. 4A) and for median residual life expectancy (Fig. 4B). This gives the clinician, besides MD, age, and progression velocity, information about the way the individual patient is heading and can be used to apply a less strict IOP control regimen in some patients. For the majority of patients, however, a tight IOP control and follow-up seem mandatory and for them, knowing that only 5.2% of patients will progress to statuary blindness and another 10.4% to visual impairment is a reassuring fact.

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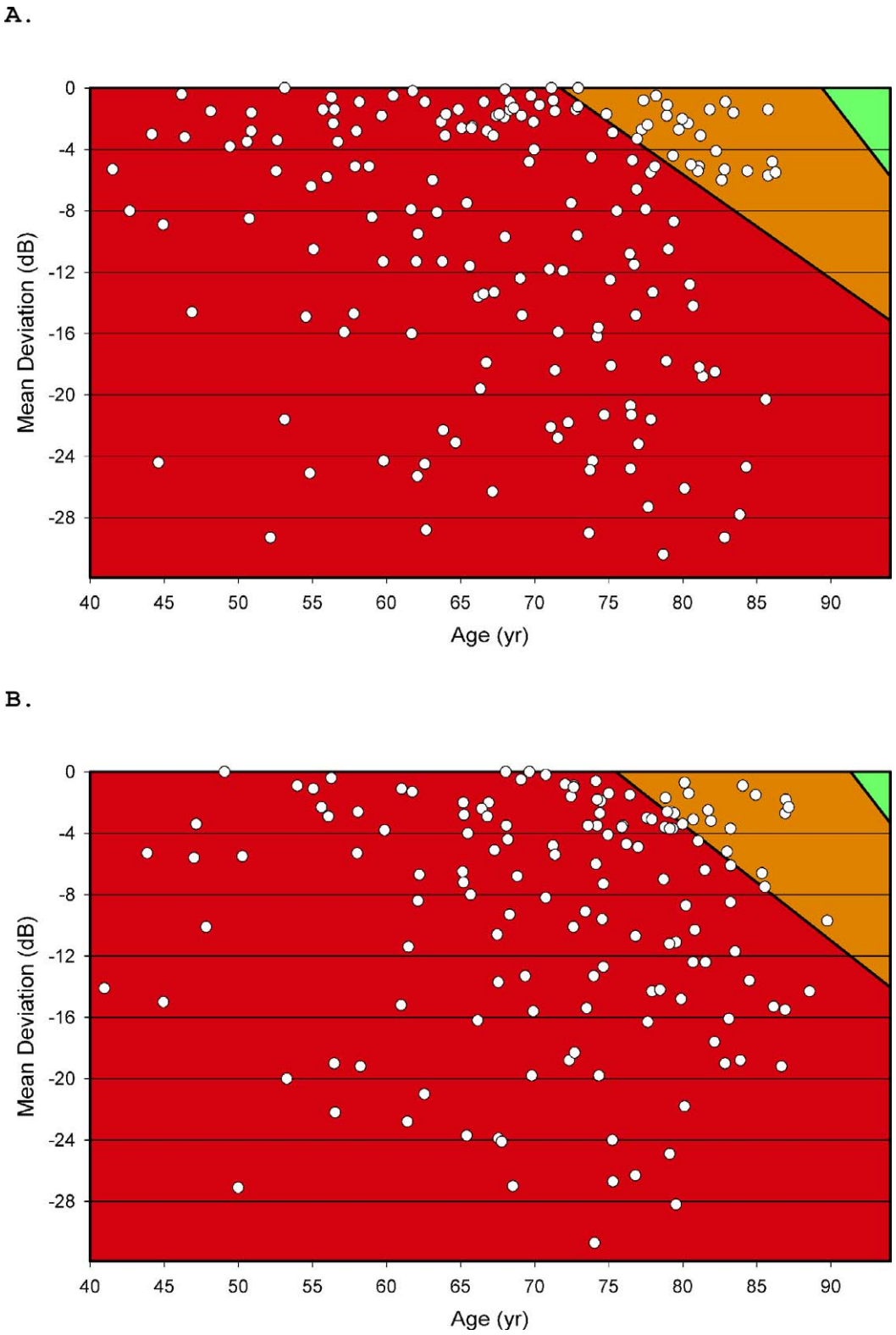

FIGURE 1. Probability of becoming visually impaired before dying for men (**A**) and women (**B**). If the combination of age and current MD brings the patient in the *red* area, the probability of becoming visually impaired before dying exceeds 2.5%, even if treated. In the *orange* area less than 2.5% if treated but more than 2.5% if untreated. In the *green* area this probability is less than 2.5% even if untreated. Visually impaired was defined as an MD of −20 dB. *Dots* represent patients enrolled in the GLGS.

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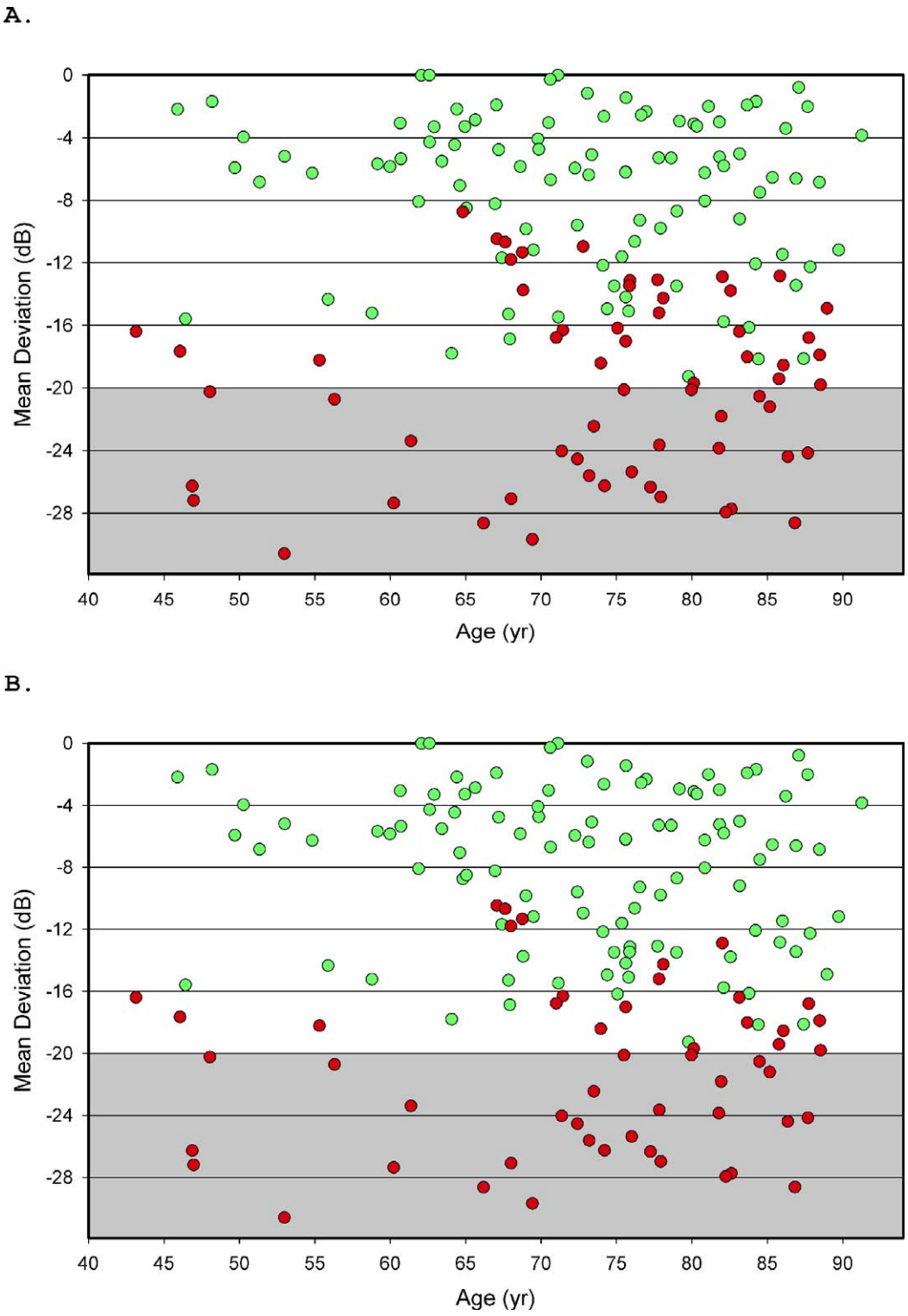

FIGURE 2. Risk of becoming blind, given the current MD, age, and rate of progression, for the 95th percentile of life expectancy (longevity; [**A**]) and mean life expectancy (**B**). *Red dots* represent patients enrolled in the GLGS who will become visually impaired, *green dots* those who will not. Visually impaired was defined as an MD of −20 dB.

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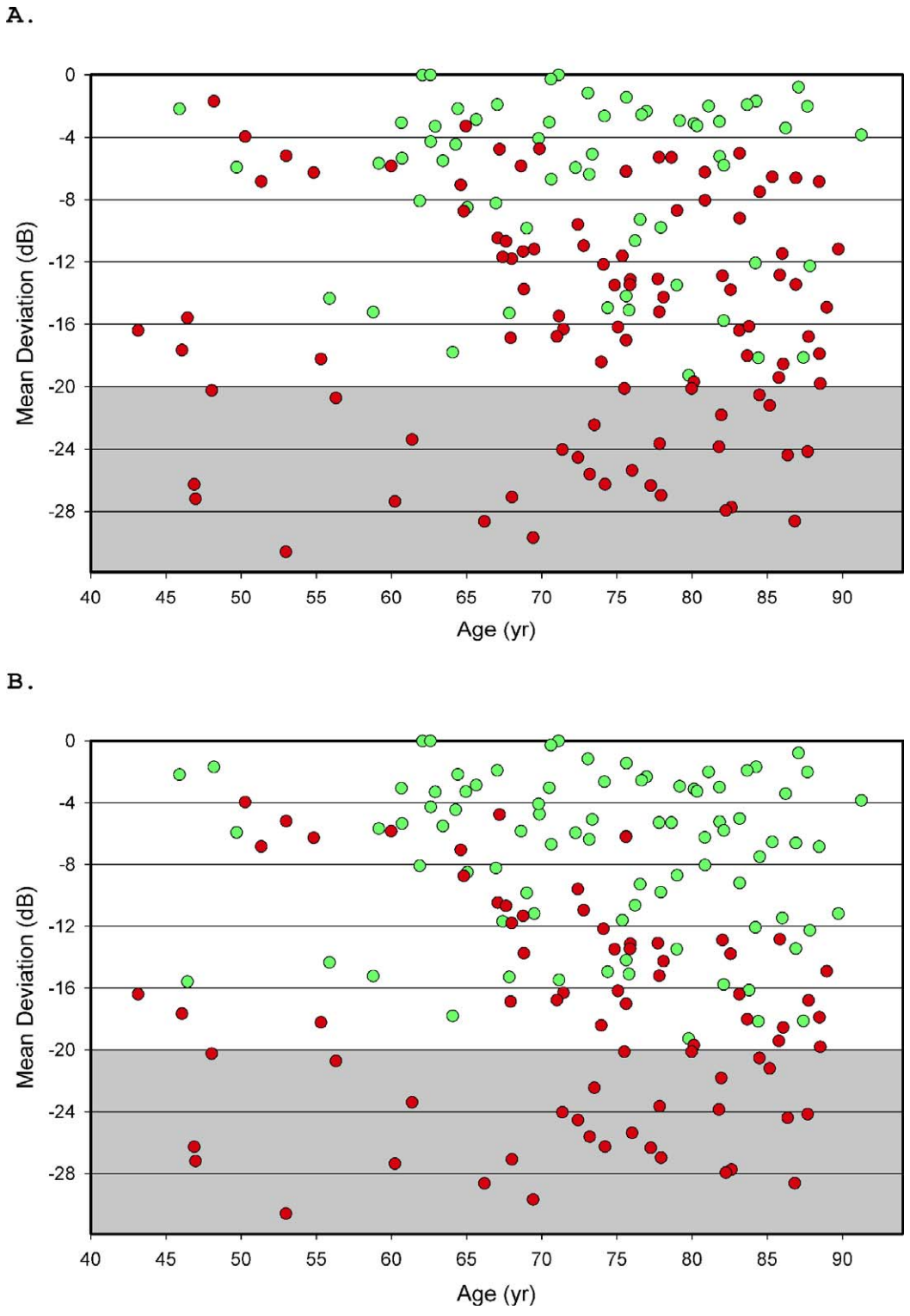

FIGURE 3. Risk of becoming blind, given the current MD, age, and rate of progression tripled, for the 95th percentile of life expectancy (longevity; [**A**]) and mean life expectancy (**B**). See also legends for Figure 2.

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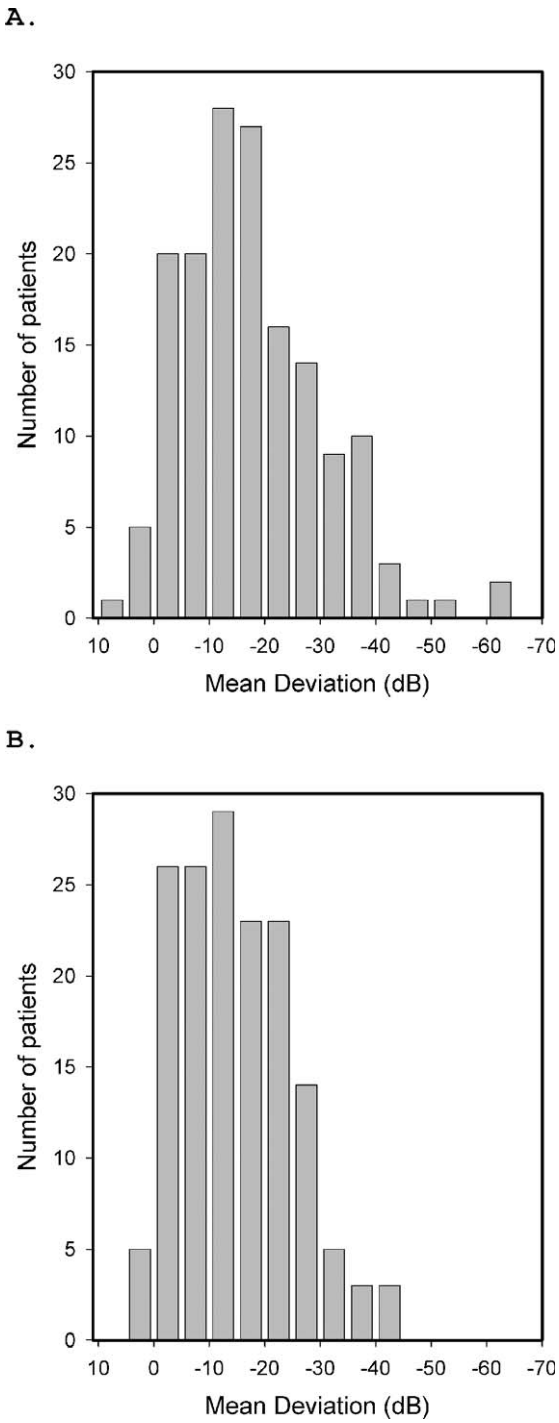

FIGURE 4. Distribution of end-of-life MD as calculated for all patients enrolled in the GLGS, given current age, MD, and progression rate for the 95th percentile of life expectancy (longevity; [**A**]) and mean life expectancy (**B**).

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